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**Three-dimensional Fluorescence Tomography of Nickel Enriched Regions In The Xylem Elements of *Salix nigra* L. growing in a contaminated wetland.**

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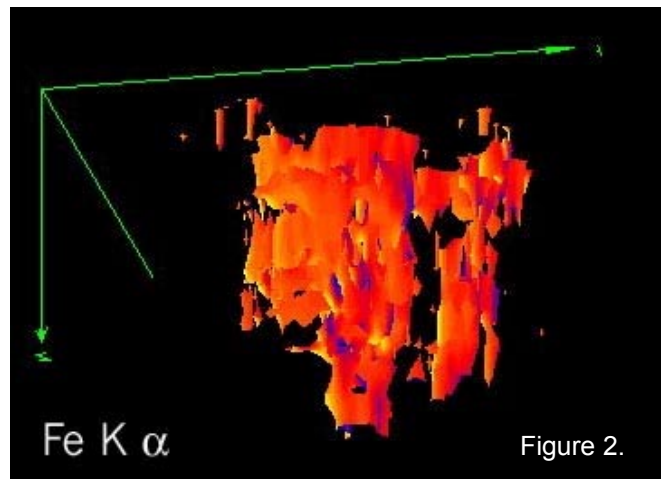
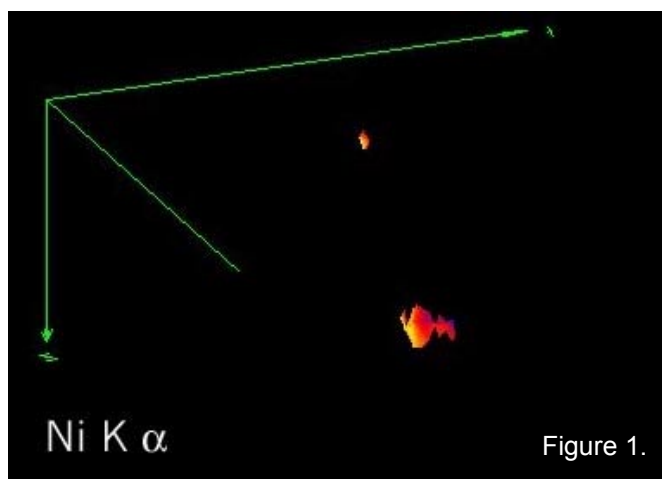
Beamline(s): X26A

**Introduction:** Previous investigations of potentially toxic trace metals within annual rings of exposed trees have questioned the ability of dendrochemical analysis to provide meaningful information about past contamination events. Dendrochemical analyses carried out using synchrotron X-ray fluorescence (SXRF) showed that Ni distribution within the annual rings of exposed willows varied both within and between annual rings (PUNS0204). Ni occurred in two distinct phases; a diffuse phase with a lower concentration, associated with annual rings, and smaller discrete regions where Ni concentration was particularly high in comparison with the surrounding tissues. The resolution and sensitivity of spatially resolved analytical techniques are therefore very important; interpretation of tree ring data could be confounded by the existence of discrete, highly enriched regions, especially when using small beam sizes. This study attempted to isolate and interrogate one of the enriched regions detected within a sample of a Ni exposed willow using three-dimensional fluorescence tomography.

**Methods and Materials:** Tree cores were collected from *Salix nigra* L. (black willow) growing on a former de facto waste site contaminated with 526-1224 mg kg<sup>-1</sup> total Ni. Cores were collected with a Teflon-coated corer (20cm x 0.5 cm), dried (60°C, 48h), and sectioned to ≈1mm thick. Ni enriched regions were removed using a Merchantek micromill, fitted with a 0.4 mm diameter tungsten carbide drill bit. The core fragment was checked by running a 2D compositional map to confirm the presence and relative location of the enriched region, before mounting the fragment on a glass filament, and placing it in a goniometer head, which allows the automated collection of three dimensional scans or 'slices'. The beam was collimated to an x spot of 15 μm, and a y spot of ~ 10 μm, and data was collected between 0-180° at 4° steps, using 50 μm steps on the y axis; scanning on the z axis was in 12 μm steps. Dwell time was three seconds live time per pixel.

**Results:** Two-dimensional compositional maps of the tree core fragment confirmed the presence of an elevated Ni region, measuring approximately 10 μm across. Previous studies of this region suggest it contains ~ 1,000 mg kg<sup>-1</sup> Ni, although calibration of the three dimensional fluorescence tomography data into elemental abundance is ongoing. The Ni-enriched region (Figure 1) is thought to reside within a xylem element, rather than constituting part of it. The enriched region can be visualized by comparing the three dimensional representation of the Ni data with that of a structural element such as Fe (Figure 2), which shows the fragment in its entirety. The non-structural quality of the Ni region strongly suggests that it is an amorphous substance, possibly an insoluble resinous substance condensed on the inner walls of a vessel element during the sample preparation. Sampling vascular tissues of trees introduces air spaces known as 'tyloses', or breaks the transpiration stream, resulting in cohesion and formation of droplets. In order to establish the nature of these enriched regions, the binding environment of the Ni (i.e. inorganic or organic) will be determined using X-ray adsorption fine structure microspectroscopy (XAFS).

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**Figure 1-2.** Three-dimensional representation of normalized counts of Ni and Fe (respectively) collected from a 0.5 mm diameter fragment of Ni enriched *Salix nigra* woody tissue.